

CLAIMS

1. A vehicle having an air bag system for impact restraint, comprising:
a vehicle body defining a vehicle interior space therein;
an occupant seat located within the interior space;
the air bag system comprising a primary gas emitting inflator for
5 emitting inflation gas upon receiving a signal of an impact, a fill tube in fluid
communication with the inflator to port the inflation gas from the inflator, and
an air bag cushion in fluid communication with the fill tube to receive the
inflation gas from the fill tube and deployable in the interior space adjacent to
the occupant seat upon the impact;

10 the air bag system further comprising at least one tether operable to a
restricted length and an unrestricted length and having a tether loop, and a dual
depth mechanism operable in a non-actuated state to retain the tether loop and
hold the tether to the restricted length and in an actuated state to release the
tether loop.

2. A vehicle having an air bag system for impact restraint, as defined
in claim 1, wherein the dual depth mechanism comprises:
a housing;
a piston disposed in the housing and translatable from a non-actuated
5 position to an actuated position;
an actuator operable to selectively translate the piston from the non-
actuated state to the actuated state; and
a stud configured for releaseably retaining the tether loop,
wherein the tether loop is releasable from the stud upon translation of
10 the piston.
3. A vehicle having an air bag system for impact restraint, as defined
in claim 2, wherein the housing further includes a first opening in fluid
communication with the fill tube and a second opening in fluid

communication with atmosphere and the piston includes a gas escape passage
5 extending therethrough and in alignment with the first and second housing
openings when the piston is in the non-actuated position and out of alignment
when the piston is in the actuated position.

4. A vehicle having an air bag system for impact restraint, as defined
in claim 2, wherein the dual depth mechanism further includes a retention
feature to hold the piston in the non-actuated position prior to deployment of
the actuator.

5. A vehicle having an air bag system for impact restraint, as defined
in claim 4, wherein the dual depth mechanism further includes a fastener
securing the piston to the housing, the piston having a slot adjacent the
fastener wherein the retention feature is a piston retention wall disposed
5 between the fastener and the piston slot such that upon actuation of the
actuator, the retention wall is released as the piston translates.

6. A vehicle having an air bag system for impact restraint, as defined
in claim 5, wherein the piston slot includes notches to slow down the piston
and to prevent piston bounce back when the piston reaches the actuated
position.

7. A vehicle having an air bag system for impact restraint, as defined
in claim 3, wherein the dual depth mechanism is secured to a downstream
open end of the fill tube such that the downstream end of the fill tube is in
alignment with the first opening in the housing.

8. A vehicle having an air bag system for impact restraint, as defined
in claim 2, wherein the dual depth mechanism is secured adjacent to the fill
tube intermediate the inflator and the cushion and the fill tube further includes
a radial opening in alignment with the first housing opening.

9. A vehicle having an air bag system for impact restraint, as defined in claim 2, wherein the piston further includes a tether loop passage through which the tether loop is routed before slipping the tether loop over the stud.

10. A vehicle having an air bag system for impact restraint, as defined in claim 9, wherein a piston portion adjacent the tether loop passage operates like a scraper to release the tether loop from the stud upon actuation of the dual depth mechanism.

11. A vehicle having an air bag system for impact restraint, as defined in claim 2, wherein the stud is located outside the cushion for visual inspection of the tether loop prior to assembly.

12. A vehicle having an air bag system for impact restraint, as defined in claim 2, further including a reverse travel prevention feature to hold the piston in the actuated position after deployment of the actuator.

13. A vehicle having an air bag system for impact restraint, as defined in claim 2, wherein the actuator is disposed within the piston.

14. A vehicle having an air bag system for impact restraint as defined in claim 2, further comprising structure to stop movement of the piston at the actuated position.

15. A vehicle having an air bag system for impact restraint as defined in claim 2, further comprising structure operable to slow movement of the piston as the piston translates to the actuated position.

16. A vehicle having an air bag system for impact restraint, as defined in claim 2, wherein the stud is fixed to the housing and the stud remains stationary during the translation of the piston.

17. A vehicle having an air bag system for impact restraint, as defined in claim 2, wherein the stud is formed by the piston.

18. A vehicle having an air bag system for impact restraint, as defined in claim 17, wherein the housing further includes a first opening in fluid communication with the fill tube and a second opening in fluid communication with atmosphere, wherein the openings remain open when the piston is in the non-actuated position and are closed by the piston when the piston is in the actuated position.

19. A vehicle having an air bag system for impact restraint, as defined in claim 17, wherein the fill tube further includes a first opening configured to contain a portion of the piston when the piston is in the non-actuated position and a second opening in fluid communication with the atmosphere, wherein the second opening remains open when the piston is in the non-actuated position and wherein the both openings are closed by the portion of the piston when the piston is in the actuated position.

20. A vehicle having an air bag system for impact restraint, as defined in claim 17, wherein the housing further includes a secondary inflator vent, and wherein the actuator is a secondary gas emitting inflator, wherein the secondary inflator vent remains closed when the piston is in the non-actuated state and gas from the secondary inflator is vented through the secondary inflator vent when the piston is in the actuated state.

21. A vehicle having an air bag system for impact restraint, as defined in claim 17, further including an extension adjacent to the housing, wherein the extension at least partially defines a tether loop passage through which the tether loop is routed before slipping the tether loop over the stud.

22. A vehicle having an air bag system for impact restraint, as defined in claim 21, wherein movement of the stud operates to release the tether loop from the stud upon actuation of the dual depth mechanism.

23. A vehicle having an air bag system for impact restraint, as defined in claim 1, further comprising a plenum having an inflation gas passage fluidly connecting the primary inflator to the fill tube and having a piston chamber.

24. A vehicle having an air bag system for impact restraint, as defined in claim 23, wherein the plenum further includes a first vent fluidly connecting the inflation gas passage and the piston chamber and a second vent fluidly connecting the piston chamber to atmosphere; and

5 the piston having a slot extending therethrough and in alignment with the first and second plenum vents when the piston is in the non-actuated position and out of alignment when the piston is in the actuated state.

25. A vehicle having an air bag system for impact restraint, as defined in claim 24, wherein the actuator is a secondary gas emitting inflator and upon actuation, gas from the secondary inflator is vented through the second vent when the piston is translated to the actuated position.

26. A vehicle having an air bag system for impact restraint, as defined in claim 1, wherein the cushion further includes:

 a horizontal tubular slot on a rear interior portion of the cushion; and
 the tether is routed through the tubular slot to the dual depth
 5 mechanism and has a first end, opposing the dual depth mechanism, fixed to a forward portion of the cushion.

27. A vehicle having an air bag system for impact restraint, as defined in claim 26, wherein the tether has a second end extending through a vent opening in the cushion.

28. A vehicle having an air bag system for impact restraint, as defined in claim 26, wherein the tether has a second end fixed to a laterally-opposing forward portion of the cushion than the first end.

29. A vehicle having an air bag system for impact restraint, as defined in claim 26, wherein the tubular slot is formed by a sewn internal pleat in the rear portion of the cushion.

30. A vehicle having an air bag system for impact restraint, as defined in claim 26, wherein the tubular slot is formed by an internal panel having two horizontal seams secured to the rear portion of the cushion.

31. A vehicle having an air bag system for impact restraint, as defined in claim 26, wherein the cushion further includes an internal panel having two vertical seams secured to the rear portion of the cushion and a secondary panel fixed to the internal panel to form the tubular slot.

32. A vehicle having an air bag system for impact restraint, as defined in claim 26, wherein the cushion further includes an internal panel having two horizontal seams secured to the rear portion of the cushion and a secondary panel fixed to the internal panel to form the tubular slot.

33. A vehicle having an air bag system for impact restraint, as defined in claim 1, further comprising:

a side vehicle door adjacent the occupant seat; and
wherein the air bag system is packaged within the vehicle door.

34. A vehicle having an air bag system for impact restraint, as defined in claim 1, further comprising:

an instrument panel forward of the occupant seat; and

wherein the air bag system is packaged within the instrument panel.

35. A vehicle having an air bag system for impact restraint, as defined in claim 1, wherein:

the occupant seat is provided for a rear occupant; and

5 further comprising a front seat forward of the occupant seat and having a seat back structure and a rear seat back surface, and wherein the air bag system is packaged within the front seat and is deployable in the interior space between the front seat and the occupant seat during an impact.

36. A vehicle having an air bag system for impact restraint, as defined in claim 1, wherein the vehicle body includes:

an upper vehicle structure and an instrument panel; and

5 the air bag system is packaged within the upper vehicle structure and the instrument panel and is deployable in the interior space forward of the occupant seat upon the impact.

37. A vehicle having an air bag system for impact restraint, comprising:

a vehicle body defining a vehicle interior space therein;

an occupant seat located within the interior space;

5 a side vehicle door adjacent the occupant seat;

the air bag system packaged within the vehicle door comprising a primary gas emitting inflator for emitting inflation gas upon receiving a signal of an impact, a fill tube in fluid communication with the inflator to port the inflation gas from the inflator, and an air bag cushion in fluid communication with the fill tube to receive the inflation gas from the fill tube and deployable in the interior space adjacent to the occupant seat upon the impact;

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the air bag system further comprising at least one tether operable to a restricted length and an unrestricted length and having a tether loop, and a dual depth mechanism operable in a non-actuated state to retain the tether loop and

- 15 hold the tether to the restricted length and in an actuated state to release the
tether loop and the tether to the unrestricted length;
the dual depth mechanism comprising a housing;
a piston disposed in the housing and translatable from a non-actuated
position to an actuated position;
- 20 an actuator operable to selectively translate the piston from the non-
actuated state to the actuated state; and
a stud configured for releaseably retaining the tether loop,
wherein the tether loop is releasable from the stud upon translation of
the piston;
- 25 wherein the cushion further includes:
a horizontal tubular slot on a rear interior portion of the cushion; and
the tether is routed through the tubular slot to the dual depth
mechanism and has a first end, opposing the dual depth mechanism, fixed to a
forward portion of the cushion.

38. A vehicle having an air bag system for impact restraint, as defined
in claim 37, wherein the piston is formed as the stud.

39. A dual depth mechanism for a vehicle air bag system
comprising:
- a dual depth mechanism housing having:
- 5 a canister receiving portion;
an inflation gas portion;
a fill tube receiving portion; and
a piston receiving portion;
- said piston receiving portion defining:
- a piston housing;
- 10 an expandable piston chamber in communication with said
piston housing, and

- an exterior wall opening;
 - a piston reciprocable in said piston housing; and
 - an actuator in said exterior wall opening and in communication
- 15 with said expandable piston chamber;
- said piston having one position in said piston housing for facilitating one depth for the air bag and another position in said piston housing for facilitating another depth for the air bag.
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